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ABSTRACT

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FINAL REPORT

Project No. 2-0146
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Lester S. Golub

A COMPUTER ASSISTED LITERACY DEVELOPMENT PROGRAM FOR CAREER ORIENTED YOUTHS AND ADULTS, AGES 14-24

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Computer Assisted Instruction Laboratory
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ABSTRACT

A COMPUTER ASSISTED LITERACY DEVELOPMENT
PROGRAM FOR CAREER ORIENTED YOUTHS, AGES 14-24

Lester S. Golub
Principal Investigator
The Pennsylvania State University

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Responsibility for the program development, program content, and program evaluation rests with the principal investigator, Lester S. Golub. Professors Harold E. Mitzel and Keith A. Hall played a major role in initiating and supporting this program to its completion. Robert M. Caldwell, now Assistant Professor at Southern Methodist University, offered his remarkable organizational and authorial talents to the program. The principal investigator owes his thanks to completion of this program to these three aboved mentioned colleagues.

The authors of the program, Maura Clancy, William Beaman, Donna Prall, Pat Mull, and Ruby Thompson were the creative persons who caused our ideas to materialize in their written, spoken, and graphic form.

The programers, Tom Emery, Marsha Young, and Carolyn Kendall, miraculously brought the author's written vision to the computer and finally to the student station.

Graphic presentation of images for the program were prepared by Leslye Bloom. Voices heard on the audio belong to all of us. The photographs are the result of William Beaman's craft.

The pupils who helped with the development and evaluation of the program and the Superintendents of Bald Eagle Area High School, Penns Valley Area High School, Philipsburg-Osceola Area High School, Bellefonte Area High School, and State College Area High School made our program worthwhile, and showed us that we have a useful educational program.

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CHAPTER ONE

PROBLEM, ACTIVITIES, AND IMPLICATIONS

Introduction, Problem, and Overview

Illiteracy and low levels of literacy haunt the American educational scene. It is estimated that there are currently about 15-20 million adult illiterates and semi-literates in the United States. These persons have a level of literacy so limited that it makes normal reading and writing functions virtually impossible. The chances of an illiterate or semi-literate person functioning as a productive citizen are slight considering the career demands of our highly literate, industrial society. The largest numbers of illiterate and semi-literates are to be found in the poverty pockets of our large cities, in the South, and in isolated rural regions such as the Rio Grande Valley and Appalachia. Much has to be done in the United States to increase the literacy level of young adults in high schools and junior colleges who have motivation and ability to become productive citizens.

The term "literacy" is used in this context to include the ability to read with a standard of ease and fluency expected of an individual in a career-oriented world. This Computer-Assisted Literacy Development Program for Career-Oriented Youth and Adults has been developed with the aim of involving the content of career information in improving the literacy level of youths and adults (ages 14-24) with limited literacy levels.

The purpose of developing this program in the computer assisted mode is to create an instructional system that has extensive flexibility, that can be used by teachers without specific training in reading instruction, that can be used in remote educational settings at times convenient to the learners. The computer assisted mode of instruction offers a teaching medium which is generally different from the traditional classroom instruction to which these students are accustomed. The student is not frustrated by trying to keep up with his classmates or having to read in disruptive environments. The student has audio

and visual aids to assist his reading comprehension. He has built-in interactive activities and immediate feedback for remediation. The student is placed, immediately, at his level of reading ability and career interest. The student has flexibility in selecting his study periods.

The broad objectives of this program are summarized as follows:

1. To develop a career-oriented reading literacy course of instruction for youths and adults (ages 14-24).
2. To provide career-oriented students with knowledge of a variety of careers within their interest and educational ability.

Justification and Purpose

Illiteracy continues to be a problem in the United States. The Survival Literacy Study (Louis Harris and Associates, reported in the Congressional Record, November 18, 1970, pp. E9719-E9723) asked the question: "How many Americans were prevented by reading deficiencies . . . from filling out application forms for such common needs as Social Security number, a personal bank loan, Public Assistance, Medicaid, a drivers license?" The outcomes of this study indicated an estimate that 13 per cent (18.5 million) of American adults failed to fill out the forms with fewer than 10 per cent errors, while 3 per cent (4.3 million) missed more than 30 per cent of the items (an item being a blank on a form).

Another study reported by the Department of Defense (1968) indicates that, of a group of 46,000 men who scored below the twentieth percentile on the Armed Forces Qualification Test (AFQT), 43 per cent had completed high school, yet 90 per cent read at or below the eighth grade level. Completion of high school does not guarantee optimal reading ability.

Defining functional literacy in terms of job related literacy demands, rather than in terms of representative reading tasks performed by adults, serves two functions: 1) it suggests targeted skill levels for adult basic training geared toward employment, and 2) an examination of the literacy demands of jobs indicates whether or not the stated literacy requirements of jobs are unnecessarily high.

Increasing concerns for employing the "hard-core" unemployed, have led manpower specialists to suggest that employers re-examine their educational requirements in the light of actual job demands (Wiener, 1968). The research reported here addresses iteslf to the problem of developing the literacy skills of the potentially "hard-core" unemployed so that they can handle the literacy demands of a set of jobs which employs a large number of the work force. The purpose of this study is also to increase the information about this set of jobs for this potential population.

Target Population

The materials developed for this study are designed for potentially "hard-core" unemployable, illiterate and semi-literate youth and young adults. The materials were designed for an interest level of 14-24 year-olds, although one 50-year-old, illiterate janitor has successfully worked his way through a large portion of the program and has learned to read with the use of the program. The question of career choice for him, however, was of little importance since his career goals will not change at the age of 50. The job information for the targeted population was an important motivational factor. In the formative and summative evaluation portion of this study, the population included high school students identified by the school counselors as having a reading level of fifth grade or below and who would profit from reading instruction and learning about the career areas as described in the materials.

The subjects used in this study for both the formative and summative validations of the program were enlisted from the following five high schools in Centre County, Pennsylvania:

1. Bald Eagle Area High School
2. Bellefonte Area High School
3. Penns Valley Area High School
4. Philipsburg-Osceola Area High School
5. State College Area Senior High School

All subjects ranged in age from 14 to 18 with sixteen years as a mean age. All students were from middle and lower-middle income families.

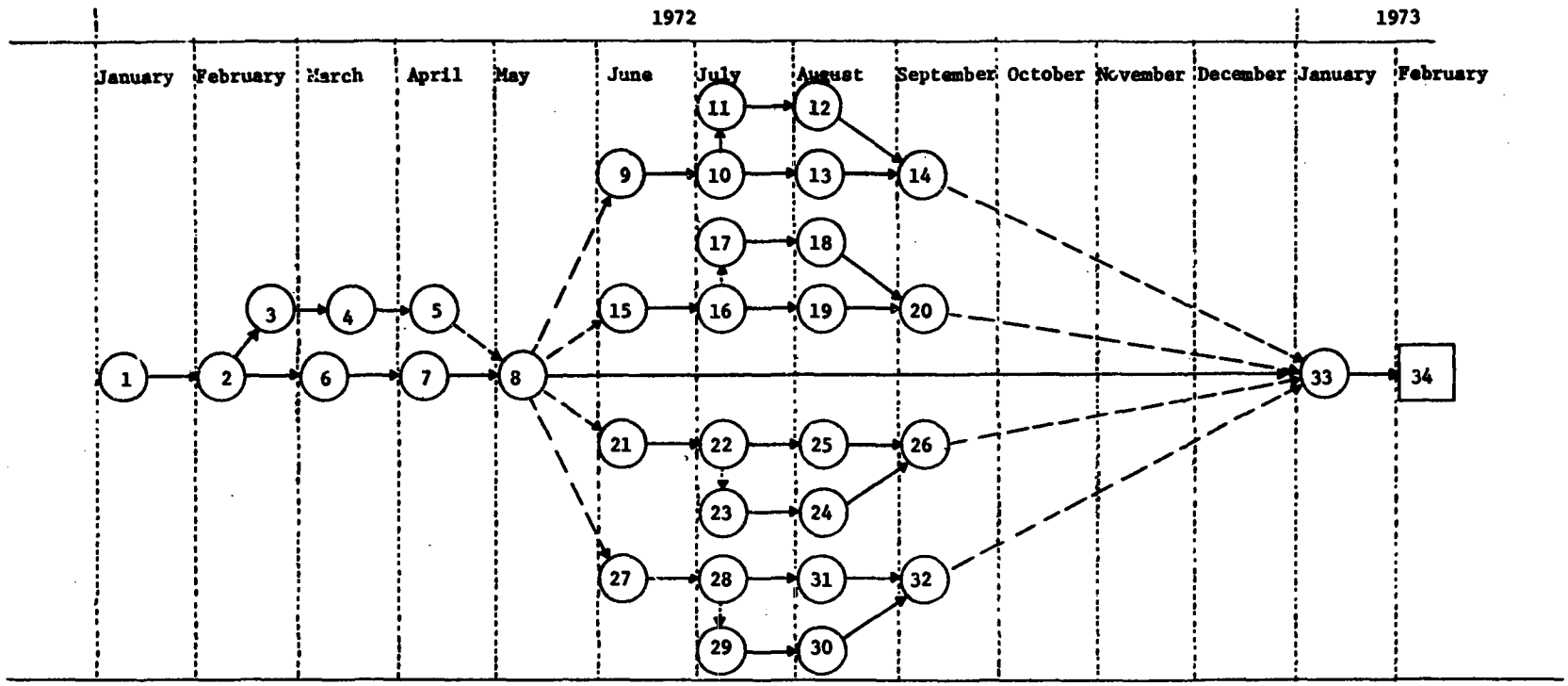
Developmental Procedure

The Computer-Assisted Literacy Development Program, henceforth called LITE, taken from the first four letters of literacy, was conceived and developed by a team of elementary, and secondary reading teachers and vocational education teachers, under the direction of Lester S. Golub, Professor of Education at The Pennsylvania State University. Thomas Long, Associate Professor of Vocational Education served as a consultant in career information. The team of research assistants used the PERT chart (see Figure 1) as a means for identifying and accomplishing events in the developmental procedure. The main steps of the developmental procedure include:

1. define project objectives
2. select evaluation instruments
3. establish teaching objectives and strategies
4. select career areas
5. research job areas
6. author job areas
7. prepare images
8. formative evaluation
9. revise and correct units
10. summative evaluation

The Approach and the Scope of the Projected Outcome

Educators have long been concerned with the problem of how reading instruction and vocational information can most effectively be practiced in the public schools. In recent years, attempts have been made to improve instruction through the process of individualization. Individualized instruction adjusts to individual progress in the sub-skills by teaching to points of weakness; it provides more opportunities for interaction and feedback from the teacher than do group analysis techniques (Evans, 1962). Thirty-three research studies comparing individualized and ability grouping approaches indicated that children taught by individualized reading instruction do at least as well on



Event Identification		Event Identification	
1. Project Start	11. Prepare Images	22. Author Level I	32. Author Level III
2. Define Project Objectives	12. Images Complete	23. Prepare Images	33. Proofread and Revise Units
3. Select Evaluation Instruments	13. Author Level II	24. Images Complete	34. Submit Units to Programer
4. Request Permission to Use Instruments	14. Author Level III	25. Author Level II	
5. Program Evaluation Instruments	15. Research Job Area 2	26. Author Level III	
6. Establish Teaching Strategies	16. Author Level I	27. Research Job Area 4	
7. Select Job Areas	17. Prepare Images	28. Author Level I	
8. Assign Units to Authors	18. Images Complete	29. Prepare Images	
9. Research Job Area 1	19. Author Level II	30. Images Complete	
10. Author Level I	20. Author Level III	31. Author Level II	
	21. Research Job Area 3		

Fig. 1. PERT chart used as a means for identifying and accomplishing events in the developmental procedure.

achievement tests as those who experienced more traditional grouping plans, and many reported greater achievement in individualized classes (Groff, 1964).

These investigations indicate that instruction becomes more effective as it is more adequately adjusted to the student's level of achievement, interest, and needs. Teachers, however, are frequently concerned about the best ways to organize a class for individualized instruction and what materials best facilitate such an approach. Computer-assisted instruction tends to offer great potential for individualized reading instruction and vocational information.

Research done at Stanford University has produced significant posttest gains in reading achievement (Fletcher and Atkinson, 1972). Hawkin, Smith, and Smith (1967) have also found the computer to be an extraordinary flexible and capable device for improving the reading abilities of disadvantaged youths and adults. Majer (1972) reviewed several research reports of programs using computer-based systems and found that programs under computer control not only resulted in significant gains in reading achievement but also had a noticeable effect on learner attitude. Majer (1972) also revealed overwhelming acceptance of computer assisted instruction in place of a teacher.

The result of the search of the literature on adult literacy, career education, and the computer are reflected in the bibliography of this text. Traditionally, career-education and literacy have been considered as two separate educational domains. Computer-assisted reading instruction is primarily the result of research with elementary school children (Suppes, 1967). The search of this literature furnished us with essential background material.

The proposed outcomes of this study are an attempt to individualize an adult reading program which is relatively teacher-proof and to present career information to potentially hard-core unemployed youths.

The outcomes of this program are a completely documented CAI literacy program for semi-literate youths, ages 14 to 24, summative evaluation data on the effectiveness of this program, and suggestions for further development, research, and implementation.

CHAPTER TWO

COURSE DESCRIPTION

Purpose

The purpose of this CAI program is to develop the reading power and vocational information of illiterate and semi-literate youths.

The course is appropriate for high school age and young adults who have not learned to read at a functional level. A functional level of literacy would start at a fourth or fifth grade reading level, with ability to read accurately at that level.

The developmental steps of this program consist of:

1. refining of objectives and research methodology;
2. research on adult literacy-career description and choices, and computer programing and authoring;
3. task assignments and the writing of LITE modules;
4. formative evaluation for content and strategy editing;
5. small scale summative evaluation to determine effectiveness of the program on a sample population.

Refining Objectives and Research Methodology

Although the research proposal for a literacy development program for career oriented youth was well developed, it was too extensive for the money finally granted the project. One main decision was to limit each phase of the program to its base essentials. The objectives of LITE Ø consisted of the following:

1. to teach Ss how to use the computer student station;
2. to teach Ss the alphabet;
3. to gather biographical data about, and by the student on the computer.

The objectives for the testing component of the program were to be able:

1. to determine the entering and and exit reading ability of the student on a standardized test;

2. to place the student in the appropriate LITE I or LITE II segment.

The objectives for the LITE I segment of the program are:

1. to teach code-breaking skills;
2. to teach job-world survival skills;
3. to bring S's reading ability up to a grade 4 level.

The objectives of the LITE II segment of the reading program are:

1. to provide job duties, training, and advantages for job areas including: 1) orderly, 2) nurse aide, 3) auto mechanic, 4) waiter, 5) chef, 6) file clerk, and 7) receptionist;
2. to provide reading activities for improvement in a) comprehension, b) vocabulary and language skill, and c) inferencial skill;
3. to bring reading ability up to functional level--about 8th grade.

Task Assignments and Writing of LITE Modules

The following assignment of tasks assured the completion of the program:

1. One project director: Lester S. Golub
2. One project coordinator: Robert Caldwell
3. Five half-time authors: Dona Prall, Maura Clancy, Ruby Thompson, Pat Mull, William Beaman
4. Two full time programers: Tom Emery, Marsha Young
5. One clerk/typist
6. Technical support from CAI Laboratory, especially for graphics, audio, and accounting assistance.

The development and explanation of the student flowchart (Figure 2), helped determine the modules and their content.

Relation of Objectives to the Decision Making Process

The objectives of the LITE program are directly related to the steps in the student flowchart (Figure 2). The first five steps of the flowchart are related to data gathering and diagnosis of the S's literacy level and vocational

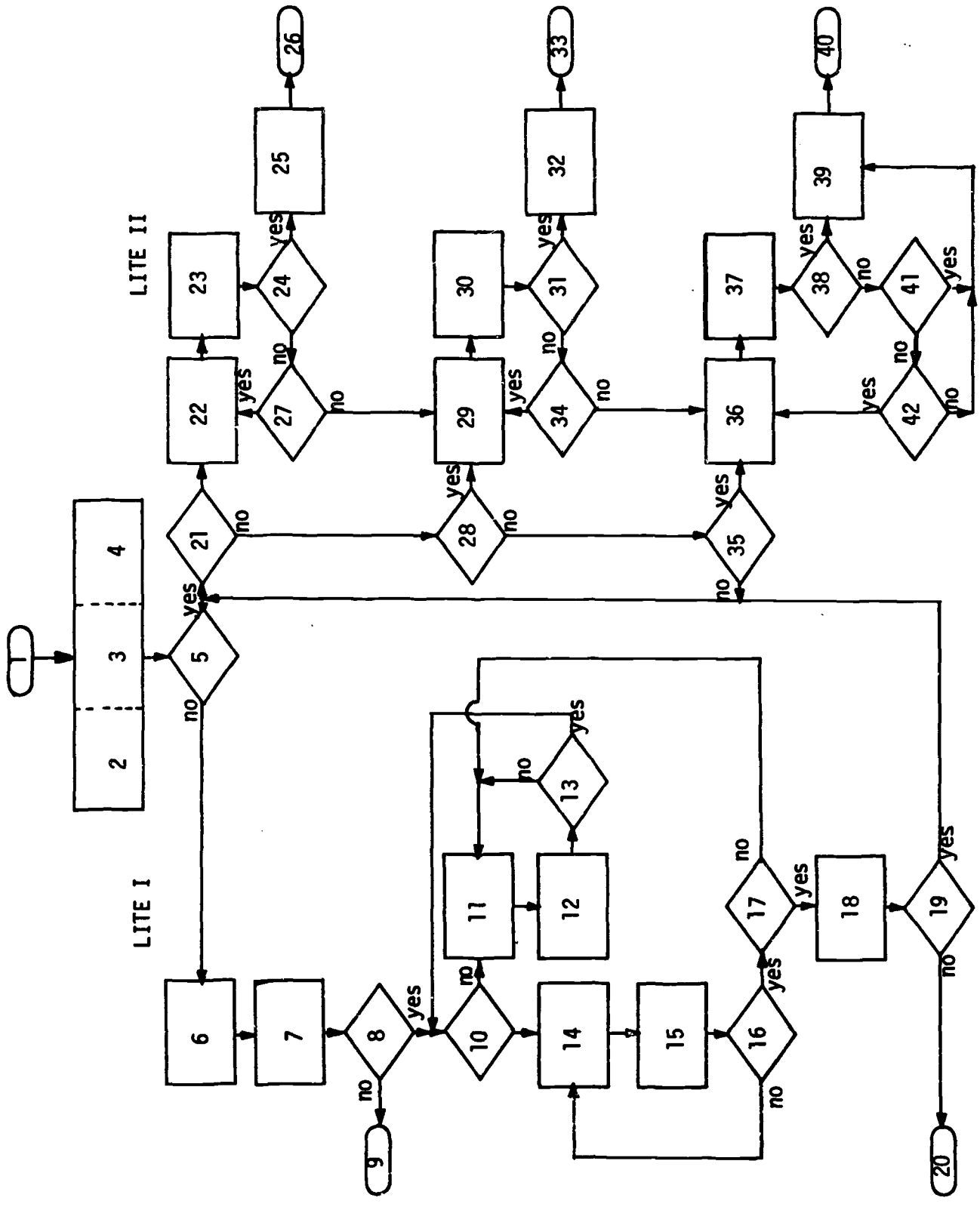


Fig. 2. Student flowchart through CAI career-oriented literacy program.

Fig. 2 - Continued -

1. Enter
2. Student Introduction to CAI
3. Instruction in Using the Keyboard
4. Collect Biographical Data on Each Student
5. Diagnostic Test: Is Student Above Grade 3 Reading Level?
6. Begin Phonics Instruction
7. Criterion Check: Phonics
8. Passed Criterion?
9. Student Pushed Out of Program
10. Reading Pool Available?
11. Continue Phonics Instruction
12. Criterion Test: Phonics
13. Passed Criterion?
14. Practice Reading Selections From the Reading Pool
15. Criterion Check: Reading Pool
16. Criterion Passed?
17. Option: Finished with Phonics?
18. Posttest
19. Continue to Lite II?
20. End
21. Pretest: Is Student's Reading Level 5-6 Grade?
22. Select Job Area, Level I
23. Criterion Test: Job Area, Level I
24. Option: Does Student Want to Terminate Program?
25. Posttest
26. End
27. Choose New Level I Job Area?
28. Reading at Grade Levels 7-8
29. Select Job Area, Level II
30. Criterion Test: Job Area, Level II
31. Option: Does Student Want to Terminate Program?
32. Posttest
33. End
34. Choose New Level II Job Area?
35. Reading at Grade Levels 9-10+?
36. Select Job Area, Level III
37. Criterion Test, Level III
38. Passed Criterion?
39. Posttest
40. End
41. Want to Terminate Program?
42. Select New Level III Job Area?

interest. This evaluation determines which level of the LITE program the student is prepared, from past experience, to enter. Evaluation should be thought of as a continuous process which is an integral part of the total educational effort. This evaluation process deals with three aspects: 1) the S's literacy development as determined on a standardized test, 2) the S's progress in the criterion referenced tests related to each unit of instruction, and 3) the S's acquisition of new information about a vocational topic. As information is obtained on the student's progress in these three areas of evaluation, decisions appropriate to new goal setting for the student can be made.

Steps 6 through 17 of the student flowchart deal with the S's progress through the initial code breaking process and the job-world orientation reading materials.

Steps 18 through 21 deal with the S's progress in the LITE I materials and the decision to send him into LITE II. Steps 22 through 42 deal with the S's job area decisions and his progress through the vocational areas. This type of student flowchart with its internal evaluation and decision making points provide the researchers with a program which could be administered without a teacher. The program has been successfully administered to high school youth, mature blue collar workers, and slightly mentally retarded youth without the use of a reading teacher. Once the student has signed on to the program, either he or the program will make decisions which will carry the S through the materials at the appropriate difficulty level for the S.

Structure of LITE Program

For pedagogical identification and administrative purposes, the LITE program is divided into four segments with each segment having its subdivisions. The general structure is shown in the following Outline of LITE.

Outline of LITE

Segments

I. LITE Ø
   - A. Biographical information (student data)
   - B. How to (use the equipment at student terminal)
   - C. Learning the alphabet and the keyboard

II. Tests
  A. Select ABLE (Adult Basic Learning Examination)
  B. ABLE I, forms a and b (vocabulary and reading)
  C. ABLE II, forms a and b (vocabulary and reading)
  D. Gordon Occupational Check List

III. LITE I: Initial Literacy Development, Grade Level 1-3
  A. Phonemic Code-breaking skills
    1. Single consonant instruction and evaluation
    2. Single vowel instruction and evaluation
    3. Sight word instruction and evaluation
    4. L blend instruction and evaluation
    5. R blend instruction and evaluation
    6. S blend instruction and evaluation
    7. Tw blend instruction and evaluation
    8. Adjacent vowel instruction and evaluation
    9. Final e influence instruction and evaluation
    10. Vowel digraphs instruction and evaluation
    11. Consonant digraphs instruction and evaluation
    12. Syllabication instruction and evaluation
    13. Silent letter instruction and evaluation
  B. World of Work Orientation Reading List
    1. Getting a job
      a. How to apply
        (1) Letters of application
        (2) Telephone inquiries
        (3) Personal interviews
      b. Where to apply
        (1) Personnel office
        (2) Whom to see in a personnel office
    2. Benefits and deductions
      a. Social Security
      b. Hospitalization
      c. Tax deductions

3. Necessary documents
    a. Birth certificate
    b. Working permit
    c. Health certificate
    d. Social Security

IV. Lite II: Occupational Area Description, Grade Level 4-8

A. Orderly
    1. Duties and requirements
    2. Training
    3. Advantages, disadvantages, opportunities

B. Nurse aid
    1. Duties and requirements
    2. Training
    3. Advantages, disadvantages, opportunities

C. Chef
    1. Duties and requirements
    2. Training
    3. Advantages, disadvantages, opportunities

D. Waiter
    1. Duties and requirements
    2. Training
    3. Advantages, disadvantages, opportunities

E. File clerk
    1. Duties and requirements
    2. Training
    3. Advantages, disadvantages, opportunities

F. Receptionist
    1. Duties and requirements
    2. Training
    3. Advantages, disadvantages, opportunities

G. Auto mechanic
   1. Duties and requirements
   2. Training
   3. Advantages, disadvantages, opportunities

H. Logger
   1. Duties and requirements
   2. Training
   3. Advantages, disadvantages, opportunities

The program is introduced by Segment I, called LITE Ø. This segment is designed to familiarize the student with the various parts of the computer terminal at the student station (the CRT, the image projector, the audio unit, and the earphones) and with the method of responding (the keyboard and the light pen). In this on-line segment the student provides biographical data (name, address, years of school) needed for record keeping, progress reports, and other official requirements. Since the students using this segment have been identified as illiterate or semi-literate, all of the instruction had to be presented in the audio mode as well as the visual mode. All directions had to be simplified and easily understandable. This segment also utilized the keyboard in order to teach the totally illiterate student the large and small letters of the alphabet as they appear on the typewriter keyboard. The reader must bear in mind that most illiterates have little or no familiarity with the alphabet.

Segment II, called Test, provides for a self-adjusting, testing, and evaluation of the student. After the student has learned how to use the student computer terminal equipment, has supplied the computer with the necessary biographical information, and recognized the large and small letters of the alphabet, he then moves on to a series of tests. His first test is the Select ABLE, a preliminary test which establishes whether he takes the ABLE I pretest or the ABLE II pretest. If the student gets a score of fifteen or higher on the Select ABLE, he proceeds to the ABLE II pretest. If the student's number correct score is below fifteen he takes the ABLE I pretest. Research data was gathered on the scores of the ABLE I and ABLE II tests.

ABLE I is constructed to test the vocabulary and comprehension skill of an adult student reading at a first through third grade reading level. ABLE II is constructed to test the vocabulary and comprehension skill of an adult student reading at a fourth through six grade reading level. The ABLE tests were consistent with the goals of the LITE materials since they tested vocabulary, language skill, and comprehension. All criterion-referenced test and question materials developed in the LITE program were coded for reference to vocabulary, language skill, or comprehension. Interpretation of information was included under the comprehension category.

A student reading at the fourth grade level or better was also given the Gordon Occupational Check List -- an interest check list designed for high school students who will not go on to college. The Gordon Occupational Check List affords measures of student interests in five major occupational areas: 1) business, 2) outdoors, 3) arts, 4) technology, and 5) services. When the student completes the Gordon Occupational Check List he is given a choice of occupational areas to read about which are at his reading and interest levels.

Once a student completes the pretest, ABLE I or II, Form A, and the Gordon Occupational Check List for students reading at above the fourth grade level, they then continue with LITE I or LITE II instructional material.

LITE I teaches sound to letter correspondences, reading of short sentences and short paragraphs dealing with orientation to the world of work: 1) getting a job, 2) benefits and deductions, and 3) necessary documents. In order to present a variety of materials it was decided to intersperse the reading pool of work-world orientation within the sound-to-symbol materials. However, it was difficult to coordinate the code breaking instruction with the words needed in the simple reading pool. It has subsequently been useful, in using these materials with a larger institution such as Elwyn Institute to sort out the work-oriented reading pool materials and to place them in a segment of their own. The information in these materials can then be used in basic adult education classes without going through the code breaking materials.

The LITE II materials are extensive. Each segment ranges from forty-five minutes of instructional time to two hours of instructional time. Depending upon the progress and branching of the individual student. Vocabulary, language

skill, and comprehension questions are coded so that students' weaknesses can be diagnosed. Only a small number of job areas were developed for this area. Students requested some job areas which had not yet been developed. A further needs assessment and further development of job areas should be considered for various types of students.

After an average of about 500 minutes, about 8 hours of instructions in the total LITE program, students then took their ABLE I or II posttest, form b.

Gordon Occupational Check List

The Gordon Occupational Check List (Dr. Leonard V. Gordon, Test Department, Harcourt, Brace and World, Inc., 757 Third Avenue, New York, New York, 10017, permission obtained for use on CAI research), has as its objective, the matching of the individual with an occupation or with a set of occupations. The assumption is that most people are capable of performing successfully in literally hundreds of occupations, but generally are interested in only a few. The Check list examines only a student's interest and not his abilities. The content of this check list is specifically relevant to non-college bound young men and women who will leave high school to enter the world of work. In theory, the Check List directs the student to occupations for study. For example, upon completion of the Check List, the student receives a statement such as, "You appear to be interested in outdoor work, please select one of the job areas for further study."

A choice display such as: farmer, logger, nursery worker, will appear on the CRT. The student makes his choice and starts the LITE II reading materials. A student may not have a dominant interest as reflected by a large number of different types of items on the Check List. In such a case he will be told this and asked to choose a selection from a variety of job areas. For the purpose of this study students started with a job area closest to their interest and then, time permitting, moved on to another job area.

The Adult Basic Learning Examination

The Adult Basic Learning Examination, ABLE, (Karlesen, B., Madden, R. and Gardner, E., Harcourt, Brace and World, Inc., Test Department, 757 Third

Avenue, New York, New York, 10017, permission granted for CAI research) was adapted to the CAI mode for administration. The vocabulary and reading portion of ABLE I and II, Forms A and B were used for this research. ABLE is an achievement test designed specifically for adult basic education groups. It secures interests and motivates performance because it poses questions in an adult context. ABLE I measures achievement Grades 1-4; ABLE II measures achievement, Grades 5-8.

In ABLE I and II the student's vocabulary is assessed independently of his reading ability. The vocabulary test is dictated in its entirety. The vocabulary test contains 50 multiple-choice items in which the student listens to sentences where three alternatives are given for the last word in each sentence. He must choose the correct word with his light pen. He is not required to read a single word. The items of the vocabulary test covers a wide variety of subject-matter content. Each item tests for a common meaning of a given word, the distracters represent common misconceptions about these works, and they are of equal or lesser difficulty than the test word.

The reading test of ABLE I and II determines how well the student can understand the meaning of sentences and paragraphs which he reads. The test consists of paragraphs of gradually increasing length and difficulty. He responds by selecting one of three choices for a missing word or phrase. Although the reading paragraphs contain a great variety of content, there is a heavy emphasis upon the every day life of adults. The vocabulary load is adjusted so as to avoid having another vocabulary test. This reading test is best used to place a student at a proper instructional level.

There were 50 multiple-choice vocabulary items and 51 multiple-choice reading comprehension items, a total of 101 items used for ABLE I, Forms A and B. There were 50 multiple-choice vocabulary items and 58 multiple-choice reading comprehension items, a total of 108 items used for ABLE II, Forms A and B.

CHAPTER THREE

COMPUTER-ASSISTED INSTRUCTION IN LITERACY DEVELOPMENT AND CAREER INFORMATION

CAI Potential for Teaching Literacy and Career Information

At first glance it appears presumptuous to hypothesize that youths between the age of 14 and 24 who have come through their public school experience as illiterates or semi-literates are miraculously going to improve their reading ability by using the CAI mode of instruction. Yet, considering the pattern of response to the educational experience which these students habitually display, there is every reason to believe that a mode of instruction different from the patterns established in the traditional school setting will benefit these students.

Consider their instructional dilemma. These students have failed to learn to read adequately in the elementary school. Not being able to master academic subject matter in junior high school they learn how to avoid activities which demand a high level of activity. If they remain in school past the compulsory age, these students will be found in a situation where they are working part time and attending basic education classes a minimal part of the time. One hour spent with these students in a reading or English classroom will reveal that at least 80 percent of the instructional hour has been wasted in banter and minor disciplinary disruptions. A teacher who has made a peace with these students might strike a more favorable instruction-to-time wasting ratio. However, it is difficult for academically oriented teachers and non-goal directed students to reach this peace.

The computer offers an immediate change to this traditional setting. In the CAI environment the gregarious student is by himself confronting the computer even though a classmate is sitting right next to him. Because each student can learn from and interact independently with the CAI program, and because the computer program can execute logical decisions based on the analysis of incoming on-line student performance data, there is built into the LITE program intelligent adaptation of instruction to the needs of each student.

The logical decision making ability of the computer program, its extremely rapid access to large amounts of stored information, and the knowledge and skill of content authors and computer programers, can provide for a wide variety of individual differences among learners. Mitzel (1967) states:

> Indeed, in sophisticated tutorial programs which involve many remedial branches and frequent examination of the learner's mastery, it is likely that no two learners in a group will ever take the same path through the material. In the tutorial mode, maximum adaptation can be made to individual differences exhibited by the learners (Mitzel, 1967, p. 5).

Computer-assisted instruction has the following advantages (Dick, 1965, p. 51) over traditional instruction:

1. The computer can carefully control the learning sequence of the students; in fact, it forces the student to comprehend each frame. It also prevents cheating.
2. The computer can judge constructed responses for accuracy. When several answers are acceptable, the student is not left wondering whether his response is correct or incorrect.
3. The computer may offer a more stimulating learning situation than the dull one sometimes provided by programed texts.
4. The computer can utilize background information on each student, including both personality traits and abilities, for constructing learning sequences and judging responses.
5. The computer is more versatile than the programed text. It can teach a wider variety of tasks and employ a wider range of auxiliary stimulus-presentation equipment.
6. The computer offers data on the entire learning session as well as summary data. These data are useful both for school records and for research purposes.
7. The computer can be used for a multitude of jobs besides instructing. Grades, reading rate, attendance, on-line time, trials, inventories, and scheduling can be processed on the computer.
8. The computer, unlike the teacher is never tired, short tempered, bored, and as a long term investment, is less expensive than teachers, books, or programed texts.

Still other considerations put a plus on computer-assisted instruction.

1. Use of CAI can generate a unique motivational environment.
2. Student populations of widely varying backgrounds can be brought together in the same environment and helped to achieve recognized literacy standards.
3. Students with lower literacy ability can be stimulated by controlling the success ratio and maximizing the learning reinforcement.
4. Student programs and teacher programs can be made available with the same CAI system.
5. Updating or changing the CAI program can be accomplished with relative ease.
6. Uniform standard of course quality control and student management is maintained in every location where the course is offered.

With these advantages in mind, it appeared to the researchers that the wish of increasing literacy levels of illiterate and semi-literate youth was worth the attempt. If such a system seemed to present some progress in the direction of making these youth productive and literate citizens, the program and the computer could then be used for further research and development. There is little question that the computer and well conceived programs will play an increasingly important role in the future of education.

Modes for Teaching Literacy Skills with CAI

The LITE program used a comprehensive set of instructional strategies to assist the student to increase his literacy level and to offer him new career information. All of the strategies force the student to interact with the course materials and to participate in the learning process.

The most prevalent strategy is the use of the tutorial mode of instruction. This instructional mode simulates the master tutor engaging in an interactive dialogue with the individual learner. The tutor presents information, asks penetrating questions, and carefully analyzes the student's responses to the questions. On the basis of the student's demonstrated understanding or lack of understanding or skill, the tutor assists in establishing new goals or

tasks for the student. In the teaching of literacy skills, the tutor can move an advanced student through the program faster than he can move a less skilled student. The computer can be a tutor for dozens of students at various levels of literacy.

The second instructional strategy is the inquiry mode. This situation also provides simulation of various career situations. This type of activity is used in the LITE II, career information portion of the program. With the use of illustrations and audio, the authors have attempted to reproduce experiences in the automobile garage, at the receptionists desk, and in the hospital. The inquiry and simulation modes are used in the LITE program for inference and problem solving. A student is given a problem which a receptionist might encounter in a day's work such as the need to alter appointment times or to screen incoming telephone calls for her employer. Given a number of choices, the student must select the most feasible possibility. If a false assumption is made because of faulty reasoning, faulty information, or insufficient or inaccurate literacy skills, the program allows the student to follow another strategy until the correct decision is made. Eventually, the student learns to attend to careful reading and interpretation of the content. The student's decisions and corrective strategies are recorded and evaluated by the computer.

The CAI Equipment

The Pennsylvania State University Computer Assisted Instruction Laboratory utilizes the IBM 1500 Instructional System. The CAI Laboratory is located in the Chambers Building of the University Park Campus of The Pennsylvania State University. Each of the 30 instructional stations contains a cathode ray tube display, a light pen, a typewriter keyboard, an audio/record unit, and an image projector.

The cathode ray tube (CRT), a small television tube, is the most important device at the student station. This device is the main interface between the student and the computer. Lines of text, special alphabets and symbols, and specially designed line drawings appear on the CRT. The screen has an area equivalent to 640 display positions, 16 horizontal rows and 40 vertical columns.

Information sufficient to fill the screen is available in microseconds from an internal random access disk. A light pen device is attached to the CRT and enables the learner to respond to displayed letters, figures, and graphics by touching an appropriate place in the screen. The coordinates of the lighted area touched are matched with the programed coordinates, and appropriate feedback is displayed. A typewriter-like keyboard is attached to the CRT. A student responds by typing an answer which appears simultaneously on the CRT at a location on the CRT established beforehand by the course author. This response is matched against a programed response with the correct feedback given. Four dictionaries of 128 characters each can be used either in programing or for a student's response. This, for example, would make it possible to teach literacy skills using special phonemic alphabets such as the i.t.a. or the Trager and Smith phonemic alphabet. Also special symbols and designs can be used which are associated with particular job areas.

A second medium for presenting course material is the IBM 1512 image projector. When loaded with a 16mm microfilm reel, the image projector is capable of showing 1,000 still photographic images in black and white, or color. The images can be individually accessed at the rate of 40 images per second under program control. The image projector has been a very valuable facility in teaching literacy skills. A reading selection is first presented sentence by sentence or small portion by portion on the CRT. As the student reads, he calls up new material by pressing the space-bar on the typewriter keyboard. When the student finishes reading the passage, he will be told the number of words in the passage, how long in minutes and seconds it took him to read the passage, and his reading rate, that is, the number of words per minute he is reading. Gradually the student will be encouraged to increase his previous reading rate record. In order to ask the student questions and to provide him with learning activities from the reading, the image projector will now show the entire selection with sentences numbered. As vocabulary, language skill, and comprehension questions appear on the CRT, the student can refer back to the reading selection in answering the questions, particularly if his first answer is an incorrect response. In such a case, the display on the CRT will tell the student to read a specific sentence on the image projector or to attempt the question again.

The image projector has also been a very useful facility in offering career information. The images are used to simulate real job situations. In the mechanical worker selection, the photographer has gone right into an automobile garage and photographed well organized and poorly organized tool boxes and tool boards. New, rebuilt, and broken automobile parts have been photographed. Some unpleasant and pleasant features of being an auto mechanic are illustrated with photographs. Pages from parts catalogues and order forms are also shown. The student is asked to answer factual, inferential, and problem solving questions related to the pictures and the written discussion which accompanies the picture on the CRT.

A third medium of presentation is the IBM 1506 audio play/record unit. By means of a four-track tape record head and compatible audio tapes, pre-recorded information is presented. The student can also record his response on one track and immediately listen and compare his pre-recorded response. The audio messages are coordinated with the other instructional presentations on the CRT and the image projector. The audio play/record unit has been a singularly important facility in teaching literacy skills, particularly in the LITE I materials. In the development of about 70 percent of the LITE program, that which appears as displayed text materials also appears as spoken information for the student. In teaching sound to letter correspondence, the audio feature is used extensively. In giving directions the audio is used extensively with the reading of the same directions. At the beginning of the instruction in all of the LITE II units, some reading materials are initially read aloud to the student while the student reads along. Gradually, this audio support is withdrawn so that the student is reading completely on his own. In the vocabulary and language skill activities, the student hears words and sentences as well as reads them. Simulated work situations and conversations are also recorded for listening/learning activities. The full potential of the audio play/record unit has been used for the program and is viable proof of the close connection between ear and eye in literacy development.

Computer equipment to support the student stations is essential. The Central Processing Unit (CPU) provides storage of data containing the completed literacy development program and student record data. It is the nerve center directing activities of the components of the student station.

Configuration of the IBM 1500 system is shown in Appendix A.

Since the computer can record and recall student responses such as the number of correct answers, the number of wrong answers, time on-line or time to complete a passage, the sequence of instruction for a particular student can be altered on the basis of his response. In the code-breaking, LITE I, portion of the program, and the basis of pre- and posttest information, a student can either omit, review, or study indepth, various sound and letter combinations. The student can read all or some of the orientation to the world of work reading selections. He can also spend varying lengths of time on these selections. In this portion of the program, the student can also elect to participate in, or omit alphabet instruction. In the career-oriented, LITE II materials, the student can select career areas which reflect his interest as revealed by the results of the Gordon Occupational Check List.

In the research and development of the LITE project, the computer was used to record a variety of information for all of the students participating in the development and the evaluation of the program.

For the summative evaluation of these materials, computerized information was recorded on:

1. Length of time students stay on line for each instructional period;
2. Number of times students return to the computer for each instructional period;
3. Number of units completed in a recorded time period;
4. Topics chosen most frequently;
5. Entering reading level on pretest;
6. Number passing phonics criterion test;
7. Length of time in phonics material, LITE I;
8. Length of time in reading pool materials, LITE I;
9. Number of correct and wrong answers, first and second tries;
10. Students meeting criterion levels: 90/90 vocabulary;
11. Exit reading level in posttest;
12. Number of job areas selected per student.

For the formative evaluation of these materials, computerized information was recorded on:

1. Length of time students stayed on-line for each instructional interval;
2. Number of times student returns to computer for each instructional period;
3. Number of units completed in a recorded time period;
4. Topics chosen most frequently.

An analysis of this data shed light on the following developmental issues:

1. Does the student learn new career information?
2. Are more than two tries per item necessary for learning?
3. Is readability (syntax and vocabulary) appropriate for the content and goals of the program?
4. Does job information include duties, requirements, advantages and disadvantages?
5. Does the organization of the reading selection and items aid the student's comprehension, vocabulary development, and language skill?
6. Can 90 percent of the students demonstrate 90 percent knowledge of vocabulary?
7. Can 80 percent of the students demonstrate 80 percent knowledge of comprehension?
8. Can 70 percent of the students demonstrate 70 percent knowledge of language skill?
9. Are comprehension questions mainly career specific?
10. Are language skill items career specific?

CHAPTER FOUR

COURSE DEVELOPMENT

All of the course development activities undertaken in this project were devoted to the development and validation of a Computer-Assisted Literacy Development Program for Career-Oriented Youth. A number of specific tasks were involved in the development and validation of this program, each task was related to the overall purpose of the project.

Task 1: Refinement of Course Description

The first task undertaken by the principal investigator and the research assistants of the LITE program was the refinement and focus of the Course Description (Chapter Two of this report). The Course Description described the content to be covered in the course and it defined the strategies to be employed in presenting the materials. It provided the framework to which specific objectives were added for the next task. When completed, the Course Description indicated the procedures that students would employ in becoming literate in career areas.

This task of determining the course description and the student's flow through the course was one of our most tempestuous periods. Many decisions had to be made on sound and available information:

1. Who would be our target population, i.e., who would be the audience reading our materials?
2. What kinds of career information would hold the interest of these students?
3. What occupational information could these students use to their best advantage?
4. What were the career expectations of these students?
5. What teaching devices would interest these students?

In order to answer these questions, many hours of consultation with specialists, teachers, prospective students, counselors, and administrators were needed.

Task 2:
Specifying Behavioral Objectives for
Program Segments and Frames

A major step in the development was the identification of the behavioral objectives for each segment of the course. This step was carried out with the principal investigator and the research assistants. Regular meetings of the LITE staff in total and individually were needed. These meetings were important for the authors of the LITE material as well as the programers, since programers had to standardize much of the instructional materials, the coding, and the research design.

The Course Development was used as the basis for developing specific objectives. Objectives and desired student behaviors and responses were determined for each interaction between student and the CAI program. For each student response item there had to be a literacy objective as well as a career information objective. Each interactive frame required some response from the student. Correct answers were determined in advance and students were given feedback, clues, and further attempts at the problem. One major problem in determining course objectives was to determine and refine objectives so that they could be executed in a reasonable time period. In general, there was a tendency to overteach rather than to underteach.

Task 3:
Preparation of Program
Material for the CAI System

Full segments of the course material was given to specific authors and programers as follows:

Phonemic Code-Breaking Segment - Ruby Thompson
Work-world Orientation - Pat Mull
LITE Ø and LITE I Material Programer - Tom Emery
LITE II and tests programer - Marsha Young
Orderly - Donna Prall and Maura Clancy
Nurse Aide - Donna Prall and Maura Clancy
Auto Mechanic - Lester Golub
Waiter - Robert Caldwell

Chef - Robert Caldwell

File Clerk - Bill Beaman

Receptionist - Maura Clancy

Auto and Visual Technician - Bill Beaman

Although authors were not expected to be programers, they did study enough programing information of Coursewriter II, to present the material to the programers on programing sheets so that maximum efficiency could be achieved between authors, programers and input technicians.

As part of the developmental strategy, each author selected his unique mode of presentation. In that way it was possible for authors to share a variety of creative strategies for course presentation. The decision to develop materials with this wide latitude of instructional strategies was a healthy one since each unit, through an exchange of ideas and information, seemed to be developed more interestingly than the preceding one.

The authoring of CAI course material is an exacting, laborious task. Each frame has to be carefully planned to meet its predetermined objective and to provide learner interaction and response with feedback. The amount and the sequence of information must also be controlled carefully. Miscalculations in authoring are hard to determine until a student actually sits down at the student station and attempts the instructional materials.

It was essential that an efficient procedure for processing authored material from author to programer and back to author again, since the writing and programing of program materials takes up most of the time in this phase of course development. The insertion and production of image statements and audio statements must be carefully transmitted to the technicians who must translate the author's ideas into usable curriculum materials. Procedures for coding of questions and drill items had to be settled early.

The procedure for producing CAI materials for the LITE program included four basic steps. First, the author wrote out instructional units as well as directions to the programer on specially designed program sheets. Each author was provided with two to five hours of instruction in programing Coursewriter II, a simple computer language used for computer assisted

instruction. Special directions to the programers usually concerned the placement of images and audio messages, the format and content of images, and the location of branching statements and blocking of information presented to the student.

In the second step, the programer edited the instructional text for the key punch operator. At this time the programer cleared up illegibilities, typographical and other mechanical problems. By the time a handwritten corpus of instructional material goes from author to project director to author to typist to programer to key punch operator and ready for initial display in the IBM 1500, many unforseen changes can take place in the content, language and format of the materials. As experience was gained, the procedure progressed very rapidly and some savings were gained. When the performance level of author, programer, and key punch operator is high, maximum production can be achieved. It is at this point that production should continue as long as possible without change in personnel. It would be wise to have more than one funded project operating at this high peak of efficiency. Error free results at this stage of development is essential since "debugging" of CAI materials is costly and time consuming. On the other hand, error free results are almost an unattainable objective.

In step three, the key punch operator, using the edited program sheets, prepared an initial deck of punched cards. These cards consisted mainly of textual materials and the Coursewriter II program statements.

The fourth step consisted of deck-building and debugging by the programer. In deck building, the programer inserted the Coursewriter statements into the contextual materials and edited some of the contextual cards. After the deck for one unit was completed, it was assembled into the computer and the programer could then put the contextual material through a process of on-line debugging. In this step the objective was to insure that assembled course material and and course flow corresponded to the specifications laid down by the author. The author was called into work with the programer at this stage of the program development.

Task 4: Testing and Revising the Program: Formative Evaluation

In the development of the LITE program, testing and revision occur continuously throughout the various phases of course development. Revision of objectives and material occured before the content was translated into programing language. Before a segment of the LITE program was given to a programer, the author first had both the project director and the project co-ordinator read the materials for revisions. During the programing of the course content, materials were revised since some suggestions of the author may be unclear or impossible to carry out on the IBM 1500 computer system. Revision also occurs during the initial debugging of the course. At this point, the author and the programer must "take" the course they have authored and programed. During this "course taking," they must also make as many mistakes as possible so that they can check the course for sequencing and content.

The formative stage of revision began as soon as enough segments of the program were available to make bussing of subjects from their community to The Pennsylvania State University campus financially feasible. At this time one illiterate, University janitor was given two hours a week of his work time to come to the CAI Laboratory to develop his literacy skills. He is still working in the program and other janitors have requested to use the program. Once again the problem is one of time and money.

For the formative evaluation, about ten students were used to provide information for the revision of the initial program. This formative evaluation and consequential revision took place during the winter quarter, 1973. To assure maximum use of this developmental procedure, a system for recording and revising errors was devised. Each student in this pilot group was accompanied by an author who recorded, on 4 x 6-inch cards, the student's comments and questions on the program and the bugs of the program such as errors in the CRT displays, graphic displays, images, and audio messages. Program revisions went to the programer, content revisions to the author and then to the programer. Such items as type of errors, number of errors, number of requests for help, response latencies, and other information were analyzed to pinpoint problems in content, pedagogy, and programing.

Careful revision and sequencing of the LITE program followed the formative evaluation. By Spring quarter, 1973, the summative evaluation took place with about forty illiterate and semi-literate high school students participating. These students also completed an attitude evaluation form at the completion of their time on the program.

Documentation

The LITE program is a thoroughly "documented" CAI course The word "document" refers to a complete printed version, and a computer readable version on computer magnetic tape, of not only the course content and strategies but to other more specialized types of information. Documentation of this course is an absolute necessity since there are no student or teacher handbooks to accompany the course. To a great extent, documentation of this course will provide valuable author and programing information to persons wanting to continue with this type of program, but who will not want duplicate the work already completed.

The purpose of the documentation is to provide information to at least three types of audiences: 1) administrators and prospective users of the program, 2) instructors who want to be familiar with the course content, and 3) authors and programers. Administrators will be interested in purchasing and curriculum planning. These persons will be interested in course content and how it fits the needs of their students and how it can be plugged into existing curriculum designs. Instructors will be concerned with the accuracy and appropriateness of the course content, teaching strategies, and the instructional media involved. Programers will be interested in the documentation for its innovative programing strategies.

The documentation for the LITE program is divided into three sections. Section one consists of representations of the cathode ray tube (CRT) displays. Along with each screen display, there are descriptions of answer processing procedures as well as descriptions of activities at a student station; the positioning of images (and their numbers), the closing of the image shutter, positioning and displaying of audio messages (and their names), descriptions of response limits, and the coded response identifiers. The answer mode, keyboard or light pen, is also indicated.

The CRT display dominates each page of printout. It is framed on the left by a column of numbers corresponding to screen rows and at the top by the number of screen columns. Within this frame appears exactly what the student sees on the CRT. Though graphics also appear, the system can provide only near representations. This section of the documentation offers a sequential and graphic representation of the LITE program. Portions of section one of the documentation can be found in Appendix B.

Sections two and three of the documentation are of use to programers and systems personnel. Section two is the coding section containing a complete list of Coursewriter II statements similar to the listing used by the programers during the course development. Section three is a complete cross-reference table showing not only which audio messages, buffers, counters, functions, film images, and labels have been used but also where they had been used with respect to course labels. This cross reference section is an invaluable tool for programers. With it they can immediately locate any of the above listed items (audio and image printouts) in any part of a course. The documentation program also has printed out all of the audio messages and summary descriptions of all the images in the LITE program. These appear, segment by segment, at the end of the three documented sections of the LITE program. Audio messages are first, in alphabetical order, followed by images in numerical order.

In the initial proposal for this project it was thought that a teacher's manual might be necessary for the program. The principal investigator now believes that with section one of the documentation, such a manual is unnecessary since the course is relatively "teacher-proof," self-administering, and self-pacing.

For research purposes, the programed text version of the CHEF portion of LITE II was constructed to parallel as closely as possible the same material in the computer mode.

Copies of the LITE DOCUMENTATION are available under separate cover.

CHAPTER FIVE

PROGRAM EVALUATION

The Evaluation of the Literacy Development Project centered on several basic questions:

1. Can computer assisted instruction adapt learning to the varying needs and abilities of illiterate and semi-literate learners so that significant gains in reading achievement result?

2. Will reading instruction under computer control create favorable attitudes in the learner toward instruction?

3. Does computer assisted instruction offer unique instruction advantages not offered in a programed text?

Three instruments were used to answer these questions. To measure over-all achievement on computer assisted presentations of LITE I and LITE II, two forms of the Adult Basic Literacy Examination (ABLE) were used. This is a standardized text developed by Harcourt, Brace, Jovanovich and is based on national achievement norms.

Learner achievement on the CAI and programed text presentations of the Literacy materials was compared using a 31 item criterion-referenced achievement test. This test was directed at assessing achievement of vocabulary, comprehension, and word skill objectives as they were specified in the occupational unit of chef. (See Appendix A)

Attitudes toward the CAI and programed text versions of the learning materials were measured using a semantic differential. This instrument is essentially a combination of controlled association and scaling procedures. The subject is presented a concept to be differentiated using a set of popular adjectives, his task is to indicate for each item the direction of his association and its intensity on a seven-step scale. (See p. 45)

Professional Consultation

The Literacy Development Project was developed through numerous conferences and consultations with a wide variety of specialized individuals and resources.

The theoretical framework of the program was founded in previous research reported by Wansen (1971), Charp and Sandstorm (1968), Fletcher and Atkinson (1972), Mynhier (1969), Hankin, Smith, and Smith (1967), and Cole (1971). These reports described a variety of computer-directed reading programs, extending from remedial and developmental uses through special education programs with illiterates. The success of these programs lent encouraging support to the notion that computer assisted instruction could be adopted to the varying abilities and needs of illiterates and semi-literates.

Instructional content was derived from several sources of occupational information and Adult Basic Education Curricula. Some of the more useful ones included:

1. Pennscript
2. Prentice-Hall Adult Education Series
3. Woppock, R. Occupational Information. New York: McGraw-Hill Book Company, 1967.
4. Occupational Outlook Handbook 1972-73. U.S. Department of Labor, Bureau of Labor Statistics Bulletin 1700, Washington, D.C.: U.S. Government Printing Office, 1972.

Strategies of reading instruction were planned under the direction of Professor Lester S. Golub and were translated into computer compatible format by a number of language arts and technical specialists. Donna Prall, Maura Clancy, Ruby Thompson, Patricia Mull, Margaret Hubicsak, William Beaman, and Robert Caldwell were the reading and language specialists employed to author instructional materials. These materials were then programed and prepared for on-line use at the computer terminal by the following technical support people: Professor Karl Borman, technical support manager; Marsha Young, Thomas Emery and Carolyn Kendall, programers; Terry Bohn, computer operator; and Leslye Bloom, computer graphic artist.

Formative Evaluation

Formative evaluation was conducted from January to February, 1973 using a total of twenty (20) students enlisted from high schools located in the

Centre County of Pennsylvania. Five students per session were transported to The Pennsylvania State University Computer Assisted Instruction Laboratory from each of four area school districts: State College, Bellefonte, Bald Eagle, and Penns Valley. These students were most helpful in providing feedback for modification of the program. Data gathered from this evaluation provided information on 1) diagnostic and evaluative test item difficulty, 2) instructional time required for each learning segment, 3) effectiveness of test material and administration time, 4) amount of new career information provided, 5) career specificity of vocabulary, comprehension, and language skill objectives.

Data were collected in two ways. Item analysis and instructional items were automatically recorded by the computer. These data were later analyzed by the programers and course authors to determine where revisions would be appropriate. Further evaluative information was collected by individual course authors who sat through the learning sequence with individual learners and kept written records of learner reactions, problems encountered and suggestions for revisions. Editorial changes were made in the program as a result of this evaluation and provided a basis for a successful summative evaluation.

Summative Evaluation

Actual on-line instruction using the literacy materials began on April 23, 1973. Thirty-seven (37) learners (not used in the formative evaluation) were enlisted from the Centre County, PA. high schools. These subjects ranged in age from 14 to 18 and were identified by their respective guidance counselors as having reading levels below fifth grade. Unfortunately, these grade placements were determined by separate reading achievement tests used in individual school districts and, as a result, provided no standard determination of grade level. It was assumed, however, that these school districts used valid evaluation instruments for assessing student abilities and that for this reason the population used represented a valid sample of semi-literate adolescents.

Students from Bald Eagle, Bellefonte, and Penns Valley were transported to The Pennsylvania State University Computer Assisted Instruction Laboratory

once a week for a two hour session for a period of 7 weeks. During this time, learners worked at their own rate through an instructional sequence determined by their individual response histories. Students from State College High School followed a similar procedure but instead attended a one hour session twice a week.

The students' progression through the instructional and evaluative procedures are summarized in the flowchart presented in Figure 3. All subjects entering the program were given the Select ABLE test to diagnose their entering reading level. A score of 15 or below on this test determined that the learner's reading level was below third grade and he was moved into LITE I. Here he was given ABLE I, Form A as a pretest and then set to work on the LITE I materials. If his score was above 15, he was directed into LITE II and given ABLE II, Form A as a pretest.

When a student completed his respective instructional programs, he was given Form B of the appropriate ABLE exam as a posttest. If a student taking ABLE I did not reach at least third grade reading level, he was given the opportunity to go back through the proper remedial channels in LITE I to reach this level. If he was successful in reaching third grade mastery, he could then go on to LITE II. A learner completing LITE II followed a similar plan only he could leave the program when reaching the sixth grade reading level.

Complete data were collected on 23 students and these are reported in Table 1. It can be seen that gains in reading achievement did occur, but they were not found to be significant when subjected to statistical analysis. Two important considerations must be kept in mind, however, in interpreting these results. First, these data represent the efforts of only 8-10 hours of instruction. Also, evaluation was based on a norm-referenced achievement test which was only incidentally related to the subject matter tasks. Taking this into account, it is not surprising that differences in pretest and posttest achievement are not significant, although it is encouraging that some gain was evident.

If reading improvement continued at this rate for 160 hours, students would have completed full mastery of the posttests.

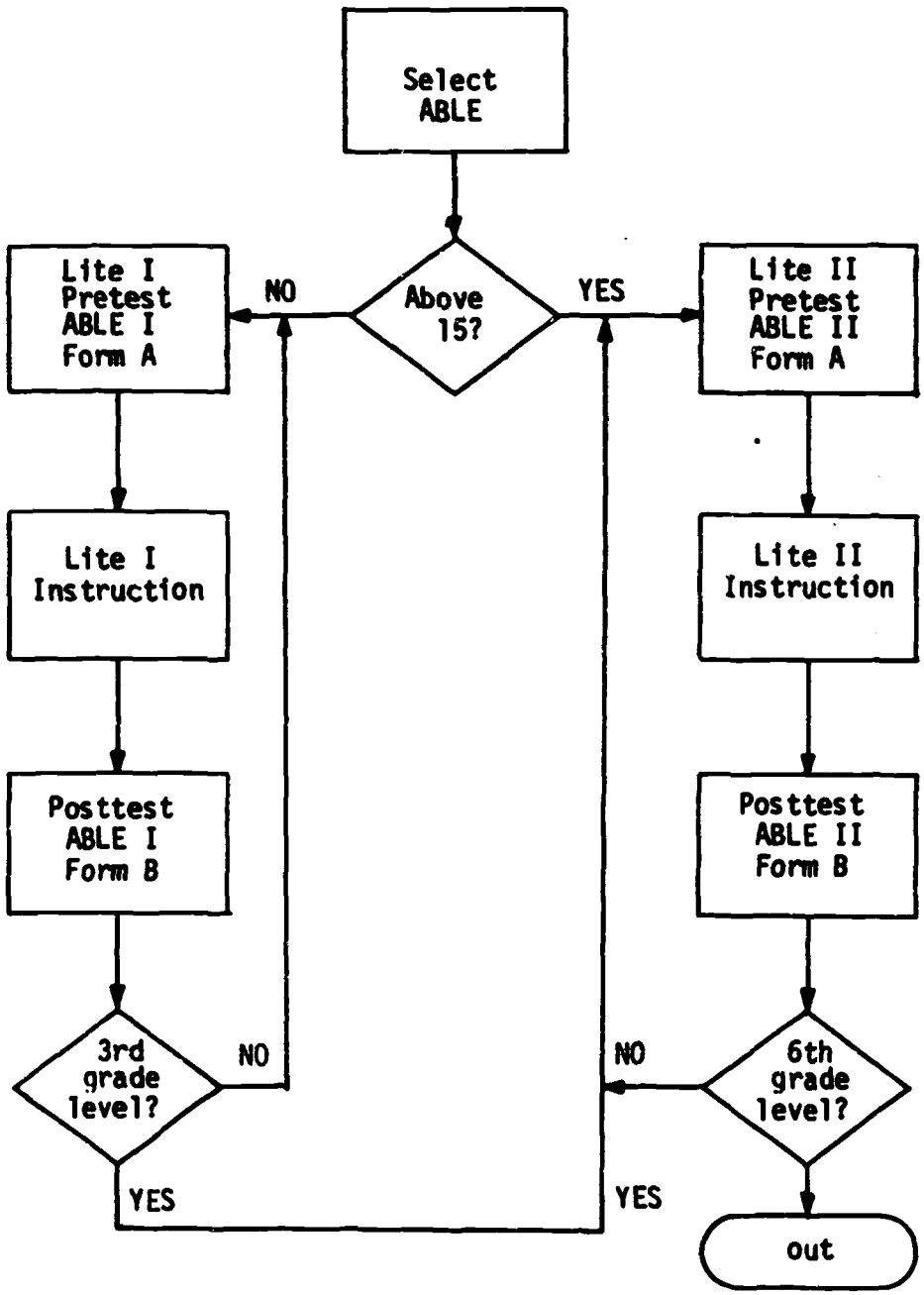


Fig. 3. Decision chart.

Table 1

Reading Achievement on LITE I and LITE II as Measured by Pre and Posttest Forms of ABLE I and ABLE II.

LITE Segment	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Significance Level
LITE I	4	73.50	8.20	78.00	5.28	P < .05
LITE II	19	76.16	9.05	77.05	4.89	P < .05
Combined LITE I & II	23	75.69	8.11	77.21	4.56	P < .05

A better indication of the program's effect on reading achievement can be determined from examining data collected from a 31 item criterion-referenced test which was part of the LITE II materials. Pretest and Posttest means obtained from this measure are reported in Table 2.

Table 2

Pretest and Posttest Reading Achievement on the Unit of Chef.

N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Total Value
18	19.17	4.22	22.22	3.28	3.92*

*Significant at the .005 level.

As the data shows, significant differences between pretest and posttest achievement were found when evaluation was based more specifically on the specified objectives of the program.

To further evaluate the effectiveness of the computer assisted program, it was in part contrasted with a presentation of the same LITE Content in a programed text. A portion of the LITE II materials on the occupation of chef was presented in a programed text to 35 students at Philipsburg High School who had been identified semi-literate and to 18 students using these materials on the computer. Their achievement was assessed using the 31 item criterion-referenced test mentioned above. The results are summarized in Tables 3 and 5.

Table 3

Reading Achievement Pretest and Posttest Means for CAI and PI Presentations.

Groups	N	Pretest		Posttest	
		Mean	SD	Mean	SD
CAI	18	19.17	4.22	22.22	3.28
PI	35	20.09	3.87	23.54	4.69

Preliminary examination of these data seemed to indicate that both groups learned from the individual treatments but that neither the computer assisted presentation nor the programed text was more successful than the other in bringing about significant achievement gains.

Analysis of these data using an Analysis of Variance with Repeated Measures (ANOVR) confirmed these initial assumptions. The ANOVR data summarized in Table 4 indicates first of all that there was no significant difference in the main effect for treatment; the nonsignificant F ratio of 1.07 simply means that the group using the computer-assisted program did not differ significantly from the programed text group on either pretest or posttest scores.

Interaction between achievement and treatment yielded a nonsignificant F of .15 indicating that neither the computer-based display nor the programed text had a differential effect on achievement. However, an F ratio of 43.31 found

significant at the .001 level indicated that differences in pretest and posttest achievement were significant for each group. What these mean, then, is that the self-instructional reading program was successful in raising student achievement on specific criterion skills in both a programed text and in a computer assisted presentation, but neither method proved more successful than the other in bringing about these achievement gains.

Table 4

Analysis of Variance (ANOVR) on Pretest and Posttest Reading Achievement Scores.

Score of Variation	d.f.	Sum of Squares	Mean Squares	F Ratio
Between Subjects				
Treatment	1	29.81	29.81	1.07 n.s.
Error	51	1421.23	27.87	
Within Subjects				
Achievement	1	292.23	292.23	46.31***
Interaction	1	.96	.96	.15 n.s.
Error	51	6.31		

***Significant at the .001 level.

To further corroborate the significant differences between pre- and posttest achievement made apparent by the ANOVR, dependent t tests were performed on the pretest and posttest means of the programed text and the CAI groups. Results of these tests are summarized in Table 5.

t values of 3.92 for the CAI group and 5.66 for the PI group at the .005 level clearly indicate that differences in pretest and posttest achievement for each group were significant. It can be assumed, therefore, that the observed differences in achievement from pretest to posttest were the result of the instructional treatment presented in a computer-based dispaly unit and in a programed text.

Table 5

t Tests for the Difference Between Pretest and Posttest Means for CAI and PI Reading Achievement.

Group	N	d.f.	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	t Value
CAI	18	17	19.17	4.22	22.22	3.28	3.92*
PI	35	34	20.09	3.87	23.54	4.69	5.66*

*Significant at the .005 level.

Summative evaluation revealed not only an increase in general reading achievement but also indicated an extremely high level of student understanding of career information. Table 6 reports the mean scores on measures of career information comprehension.

Table 6

Mean Percentage of Career Information Comprehension With 80 Percent as Established Criterion Level.

Career Selection	Percent of Comprehension Items Answered Correctly on First Try Response	Number of Comprehension Items in Each Selection
Orderly	88.83	N = 29
Nurses Aide	89.53	N = 43
Chef	84.26	N = 19
Waiter	87.18	N = 11
File Clerk	90.94	N = 52
Receptionist	98.43	N = 71
Mechanical Worker	70.73	N = 15

Posttreatment attitude measures are summarized in Table 7. Upper and lower limits of positive and negative attitudes can be referenced on the following scale:

Table 7

Means and Standard Deviations of CAI and PI Attitude Scores on the Semantic Differential.

Group	N	Mean	SD	d.f.	t Value
CAI	17	136.29	25.8	54	2.85*
PI	38	118.29	14.16		

Extremely Negative Attitudes	Neutral Attitudes	Extremely Positive Attitudes
25	100	175

*p < .05

Using this scale, it becomes obvious from examining the means reported in Table 7 that students using the CAI presentation of the literacy program and those using the programed text had relatively positive attitudes toward the medium they used. A comparison of these means using a t test for independent groups, however, indicated that attitudes of semi-literate adolescents using the computer-based display unit were significantly higher at the .05 level than attitudes of those semi-literate adolescents using a programed text.

A further comparison of student attitudes toward the computer-based display unit and the programed text was made by calculating mean responses to each item for both groups on the semantic differential. These 25 item means along with their respective standard deviations were then subjected to t tests to determine on which items these two groups differed significantly. Item means, standard deviations, and resulting t values are reported in Table 9.

Minus t values reported in Table 9 represented items which were responded to more favorably by the programed text group than by the CAI group. Also, significance levels are reported at three levels, .05, .01, and .001. Examining these data, it can be seen that the PI students differed significantly from the CAI group on only two items: "easy-hard" and "fast-slow". The remaining 15 items for which significant t values were found indicate more favorable attitudes for the CAI group. Table 8 summarized the specific concepts to which the CAI group responded more positively and at which levels of significance.

Table 8

Specific Concepts to Which CAI Students Responded More Positively Than PI Students.

.001	.01	.05
exciting	alive	enjoy
interesting	like	important
necessary	rewarding	certain
meaningful		good
valuable		flexible
effective		
relaxing		

It is interesting to note that out of 17 items which were found to represent significantly favorable attitudes toward a mode of instruction, 88 percent of them favored the CAI group. It is also interesting to examine how each of these groups responded to certain specific categories on the semantic differential. On the choice of "interesting-boring," for example, 70 percent of the CAI group found the program extremely or very interesting while none found it extremely or very boring. Comparing this to the reaction of the PI group on the same item,

only 36.8 percent found the programed text version extremely or very interesting and 28.9 percent found it very or extremely boring. Similar comparisons can be seen in Table 10 and are offered here only to underscore the significant differences found in the attitudes of the CAI and PI groups.

A Student Performance Summary (SPS) chart was maintained daily on student progress through the LITE program. Data were collected on the following: 1) student number (USER), 2) segment number (SEG), 3) minutes on line (MIN), 4) comprehension items correct (C6), 5) vocabulary items correct (C7), 6) language skill items correct (C8), 7) comprehension items tried (C9), 8) vocabulary items tried (C10), 9) language skill items tried (C11), 10) Select ABLE number of items correct (C20), 11) ABLE number of vocabulary items correct (C21), and 12) ABLE number of reading items correct (22). Appendix B contains one sample of an early Student Performance Summary Sheet, dated 04-27-1973, and the last Student Performance Summary Sheet, 06-04-1973.

Table 9

t Values for Differences in Mean Item Responses to
The Semantic Differential for CAI and PI Semi-literate Adolescents

Item	CAI		PI		t Value	d.f.
	Mean Response	SD	Mean Response	SD		
1. exciting - dull	2.56	1.19	3.97	1.33	4.81***	73
2. alive - lifeless	2.97	1.17	3.95	1.89	2.71**	74
3. interesting - boring	2.03	1.24	3.66	2.27	3.87***	74
4. dread - enjoy	5.24	1.71	4.11	1.97	2.66*	74
5. dislike - like	5.72	1.71	3.92	2.13	4.02**	73
6. unnecessary - necessary	5.22	1.38	3.87	1.85	3.57***	73
7. easy - hard	2.47	1.72	1.24	0.84	-3.88***	73
8. meaningful - meaningless	2.00	1.09	3.68	1.84	4.83***	74
9. unimportant - important	5.35	1.79	4.24	1.84	2.63*	73
10 successful - unsuccessful	2.19	1.05	2.76	2.03	1.53 n.s.	73
11. rewarding - discouraging	2.65	1.56	3.97	1.91	3.28**	74
12. valuable - worthless	2.27	1.22	3.79	1.92	4.10***	74
13. unfair - fair	5.38	1.92	4.97	1.97	0.91 n.s.	74
14. impractical - practical	5.03	1.55	4.47	1.97	1.37 n.s.	74
15. exact - inexact	2.81	1.37	3.24	1.87	1.13 n.s.	73
16. uncertain - certain	5.24	1.55	4.26	1.97	2.36*	71
17. organized - disorganized	2.22	1.32	2.61	1.89	1.04 n.s.	74
18. effective - ineffective	2.22	1.12	3.26	1.92	2.87**	74
19. good - bad	1.65	1.07	2.53	2.00	2.38*	74
20. relaxing - boring	2.23	1.20	3.76	2.11	3.85***	72
21. harmful - helpful	5.81	1.57	5.37	1.86	1.11 n.s.	74
22. fast - slow	3.22	1.95	2.11	1.87	-2.50*	73
23. flexible - inflexible	2.57	1.42	3.50	2.12	2.24*	74
24. informative - uninformative	2.75	1.55	2.61	1.69	-0.37 n.s.	71
25. old - new	6.00	1.63	5.35	2.23	-1.43 n.s.	73

*$p < .05$
**$p < .01$
***$p < .001$

Table 10

Number and Percentage of Extreme Responses to Selected Items on The Semantic Differential for CAI and PI Semi-literate Adolescents.

Item	CAI			PI		
	Total N	Percent	Extreme Response N	Total N	Percent	Extreme Response N
like	37	66.0	24	38	28.9	11
dislike		5.4	4		29.0	12
valuable	37	62.1	23	38	29.9	11
worthless		0.0	0		21.1	8
meaningful	37	70.2	26	38	28.9	11
meaningless		0.0	0		18.4	7
successful	36	66.7	23	38	55.3	21
unsuccessful		0.0	0		15.8	6
effective	37	62.1	23	38	44.8	17
ineffective		0.0	0		15.8	6
relaxing	35	65.7	23	38	31.6	12
tiring		0.0	0		28.9	11

CHAPTER SIX

SUMMARY AND RECOMMENDATIONS

The purpose of this project was to develop and validate a computer assisted literacy development program for career-oriented youths (ages 14-24). This goal has been accomplished, not in a complete sense, but it has established a model for a total computerized reading program for career-oriented young adults.

The end product of this program consists of a completely computerized reading program which will diagnose reading level, occupational interest and provide literacy and occupational instruction at a literacy level of grades 1-6. Under separate funding arrangements, the LITE program (LITE for the first four letters of literacy) is being offered to special education students in the adult basic education at Elywin Institute, a Pennsylvania school for the mentally retarded. Also some adult illiterates on and near the Pennsylvania State University are taking the course.

Several stages of development were required to produce the LITE program. First, an intensive review of the relevant literature on career information and adult literacy teaching was carried out. Subsequent program development was carried out and decisions made at the initial conception of the program. As the course authors prepared the sequence of testing and instruction, the educational programers translated the materials into Coursewriter II for use with the IBM 1500 Instructional System. After a pilot group participated in a formative evaluation of the program, revisions were made and another group participated in the summative evaluation.

The summative evaluation showed that students participating in the LITE program made considerable gains in their literacy level and outstanding gains in knowledge of career information. A comparison of students using a programed test and those using CAI instruction showed the attitude of the CAI group to the CAI mode significantly more favorable than those taking the programed test portion.

Some Recommendations

1) Since the program is successful, funds should be found to implement the existing program either at The Pennsylvania State University CAI Laboratory or in the Penn State Mobile CAI Van.
2) LITE I materials are extremely effective. The orientation to the world of work reading pool in LITE I should be expanded to meet the needs of adult basic education persons, special education persons, disadvantaged adults, and prison inmates.
3) LITE II materials are extremely effective. More materials should be developed to meet the career interests of special groups of young adults and that will extend the literacy range of the program to at least a tenth grade level.
4) Teachers should become informed of the content and instructional strategies for the program so that parallel materials can be introduced into secondary and adult reading classrooms where computer assisted instruction is not yet available.

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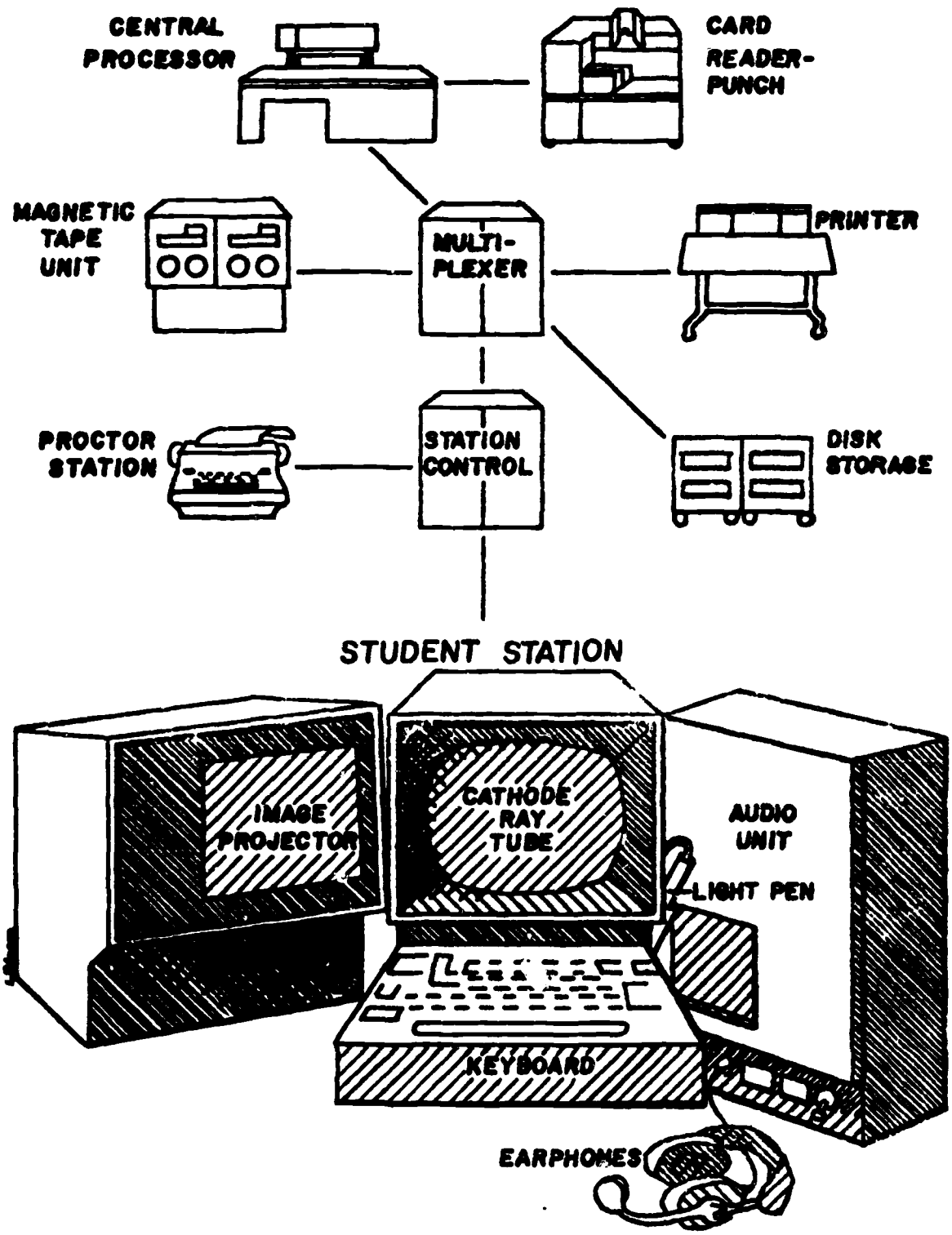
APPENDIX A

IBM 1500 SYSTEM CONFIGURATION


CENTRAL PROCESSOR
CARD READER-PUNCH
MAGNETIC TAPE UNIT
MULTI-PLEXER
PRINTER
PROCTOR STATION
STATION CONTROL
DISK STORAGE
STUDENT STATION
IMAGE PROJECTOR
CATHODE RAY TUBE
AUDIO UNIT
LIGHT PEN
KEYBOARD
EARPHONES

APPENDIX B

STUDENT PERFORMANCE SUMMARY SHEETS

Dates 04-27-1973 and 06-04-1973

COURSE--LITE U SECTION CRITERION DATE--04-27-1973

UOO = W*****,Z*****
TOO = 1, 32767

USER	SEG.	MIN.	C6	C7	C8	C9	C10	C11	C20	C21	C22	LABEL
WCS	0	32	0	0	0	C	7	0	0	0	0	AA20A
WCS	0	33	0	0	0	C	4	0	0	0	0	AA20A
WCG	0	34	0	0	0	C	0	C	0	0	0	AA20A
WCL	0	32	0	0	0	0	0	0	0	0	0	AA20A
WCW	0	28	0	0	0	C	7	C	0	0	0	AA20A
WJW	1	31	0	4	6	0	8	C	0	0	4	SA01A
WRC	0	30	0	0	0	C	7	C	0	0	0	AA20A
WRT	1	32	0	8	5	C	0	C	0	0	4	SA01A
WST	0	28	0	0	0	C	0	0	0	0	0	AA20A
XDM	23	196	18	11	36	17	3	38	37	0	56	FT01A
XCC	23	184	8	11	11	9	3	C	33	1	50	FS13A
XCE	1	92	0	8	5	0	0	C	19	0	4	BN01A
XDE2	23	189	0	4	9	0	0	C	15	33	31	FR12A
XER	23	188	8	8	6	9	3	0	26	0	45	FS13A
XGL	1	83	0	7	6	C	0	C	30	0	4	BN01A
XJK	1	93	0	5	6	0	0	C	31	45	4	BN55A
XJW	23	75	9	3	0	9	3	0	0	0	0	FS13A
XRB	23	43	0	0	0	0	0	0	0	0	0	FR12A
XRH	23	181	0	4	7	C	0	C	22	31	38	FR12A
XRP	1	80	0	7	10	C	0	C	9	39	4	BL55A
XRR	1	101	0	7	7	0	0	0	41	47	4	BN55A
XTC	23	78	8	2	1	9	3	C	0	0	0	FS13A
XTP	23	160	0	5	7	C	0	0	18	32	47	FR12A
XTS	23	115	8	3	1	9	3	0	0	0	0	FS13A
X8	7	443	0	6	8	0	15	C	0	18	18	BB13A
YBF	23	141	0	6	7	C	3	C	18	37	36	FSC1A
YCD	23	177	0	6	11	0	0	C	20	35	23	FR12A
YCS	23	165	0	5	8	0	0	0	22	27	32	FR12A
YFG	23	138	0	6	7	C	0	C	21	32	30	FS01A
YJG	5	129	0	5	5	C	0	0	9	42	51	LINKER
YJM	23	166	0	6	7	0	0	0	22	29	37	FR12A
YKE	5	152	0	4	7	C	0	C	13	41	12	LINKER
YKF2	23	157	0	6	4	0	0	C	21	22	31	FS01A
YLB	6	174	0	6	7	0	1	C	13	46	19	EA05A
YTW	23	163	0	7	7	C	0	C	19	31	39	FRC8A
ZHG	23	123	0	4	11	C	0	C	21	37	31	FS01A
ZDH	1	93	0	4	7	0	0	C	24	40	4	BN55A
ZJC	23	109	0	4	7	C	0	C	21	41	49	FS01A
ZKE	23	118	0	6	9	0	0	C	23	26	42	FR12A
ZMB	5	109	0	5	6	0	0	C	14	40	46	LINKER
ZRK	1	41	0	4	7	C	0	0	25	0	4	BNC1A
ZRK	0	9	0	0	0	C	0	C	0	0	0	LINKER
ZSB	23	117	0	6	7	0	0	C	28	40	56	FR12A
Z.C	23	125	0	4	6	0	0	0	30	33	48	FR12A
ZTR	1	44	0	4	7	C	0	C	23	0	4	BNC1A
Z11	5	74	0	4	6	0	0	0	14	23	22	LINKER
Z114	12	720	32189	0	0	2	3	C	44	46	49	WF12A
Z39	7	403	0	8	7	C	1	C	33	16	48	GA01A
		129.75										
		121.43										

MEANS (1ST LINE) AND STANDARD DEVIATION (2ND LINE) FOR N=48

COURSE--LITE U SECTION CRITERICA DATE--C6-C4-1973

LCO = W******,Z*****
TOO = 1, 32767

USER	SEG.	PIN.	C6	C7	C8	C9	C1C	C11	C2C	C21	C22	LABEL
WBS	23	264	15	11	14	15	10	11	0	C	29	FTC9A
WCS	23	235	7	11	9	9	7	C	C	0	32	FS13A
WCP	23	176	0	7	8	C	0	C	C	3	45	FR12A
WCG	23	262	12	7	14	15	3	1C	C	C	35	FTC9A
WCL	24	275	19	12	31	17	3	38	0	C	52	FCC1A
WCW	23	258	8	7	11	9	7	C	C	0	22	FS13A
WEB	23	229	8	3	1	9	3	C	C	1	51	FS13A
WJW	23	215	8	7	7	9	11	C	21	1	4	FS13A
WMG	23	250	12	8	7	13	3	C	C	0	4	FT17A
WRC	2	243	13	9	7	15	10	C	C	C	26	VP65A
WRT	23	66	0	8	5	C	0	C	C	C	4	FRC8A
WST	23	245	11	9	14	15	3	6	C	1	52	FSC1A
XEM	3	546	122	50	57	127	50	59	37	17	56	BC85A
XCD	3	562	81	34	54	93	27	54	33	36	43	BC85A
XCE	3	51C	41	34	38	54	28	47	19	38	39	BC85A
XDE	1	94	0	15	11	C	0	C	24	7	5	BN10A
XDE2	3	53C	22	11	12	27	13	7	15	32	38	BC85A
XER	3	487	53	20	47	56	14	55	26	32	48	BC85A
XGL	3	376	24	16	34	31	10	45	3C	3C	4C	BC85A
XJK	23	325	53	22	18	57	22	13	31	43	52	WAC1A
XJW	3	405	32	15	22	3C	15	4C	C	45	46	BC85A
XRB	23	43	0	C	0	C	C	C	C	C	0	FR12A
XRH	3	582	57	17	3C	66	19	56	22	34	44	BC85A
XRM	24	558	43	29	38	55	27	-48	9	C	29	FC5CA
XRR	21	587	102	38	47	112	35	52	41	C	57	CSC6A
XTC	23	78	8	2	1	9	3	C	C	C	C	FS13A
XTP	22	359	32	12	12	39	8	8	18	C	47	WAE8A
XTS	23	115	8	3	1	9	3	C	C	0	C	FS13A
XW	10	786	2	3	4	C	C	C	C	18	18	WAC5A
YBF	3	605	85	32	43	1C2	32	46	18	41	33	BC85A
YCC	3	61C	55	27	37	68	33	52	2C	39	23	BC85A
YES	3	579	74	28	41	93	34	57	22	25	39	BC85A
YFG	3	586	79	34	36	111	39	52	21	31	34	BC85A
YJG	3	584	-1	C	C	2	0	C	9	48	47	BM85A
YJM	3	553	55	31	37	71	29	52	22	29	63	BC85A
YKE	3	491	24575	-8192	17	4	1	C	13	34	25	BM85A
YKF2	25	532	64	34	22	85	33	18	21	C	31	REC1A
YLB	3	606	-68	8192	1	2	0	C	13	43	34	BM85A
YTW	3	615	39	23	18	52	24	14	19	33	33	BC85A
ZBG	25	39C	16	1C	35	17	3	3B	21	39	44	REC1A
ZCH	3	398	54	28	4C	56	29	47	24	34	42	BC85A
ZJC	3	498	64	37	47	75	38	54	21	43	40	BC85A
ZKE	3	477	73	38	59	78	31	6C	23	3C	43	BC85A
ZMB	3	480	-4099	1	2	6	C	C	14	38	44	BM85A
ZRH	23	116	0	4	8	C	C	C	25	42	53	FR12A
ZRK	0	9	0	C	0	C	0	C	C	C	C	LINKER
ZSB	3	419	71	31	41	81	29	52	28	41	51	BC85A
ZTC	3	373	22	12	27	29	10	29	3C	35	5C	BC85A
ZTR	3	417	60	30	45	69	29	52	23	37	40	BC85A
		387.73										
		188.8C										

MEANS (1ST LINE) AND STANDARD DEVIATION (2ND LINE) FOR N=49